

None of the claims have been amended herein. Please note that all claims currently pending and under consideration in the referenced application are shown below.

Listing of Claims:

1. (Previously Presented) A method for forming a metallic damascene structure, comprising:
forming a damascene opening to expose a metallic layer in a damascene structure, forming a damascene opening comprising exposing at least a portion of the metallic layer to an oxidizing agent, the oxidizing agent causing an oxidation injury to the at least a portion of the metallic layer;
exposing the metallic layer to a reducing plasma to at least partly reverse the oxidation injury;
applying a cleaning process to the damascene structure; and
forming a metallic plug in the damascene opening, the metallic plug in electrical connection with the metallic layer.
2. (Original) The method according to claim 1, further comprising forming the metallic layer from copper.
3. (Original) The method according to claim 1, further comprising forming the metallic layer from a metal having an easily reducible oxide.
4. (Original) The method according to claim 1, further comprising forming the metallic layer from at least one metal selected from the group consisting of palladium, platinum, nickel, copper, gold, silver, and cobalt.
5. (Original) The method according to claim 1, further comprising generating the reducing plasma as a hydrogen plasma.

6. (Original) The method according to claim 5, further comprising generating the hydrogen plasma to include at least one inert gas.

7. (Original) The method according to claim 6, further comprising selecting the at least one inert gas from at least one of argon and nitrogen.

8. (Original) The method according to claim 2, wherein the oxidation injury comprises formation of copper oxide.

9. (Original) The method according to claim 8, further comprising at least partly reversing the oxidation injury by reducing the copper oxide to copper.

10. (Previously Presented) The method according to claim 1, wherein forming a metallic plug in the damascene opening comprises forming a metallic plug that passes through a first intermetal insulating layer and a second intermetal insulating layer.

11. (Previously Presented) The method according to claim 1, wherein forming a metallic plug in the damascene opening comprises forming a metallic plug that passes through a first intermetal insulating layer, a second intermetal insulating layer, and a third intermetal insulating layer.

12. (Previously Presented) The method according to claim 1, wherein forming a metallic plug in the damascene opening comprises forming a metallic plug that passes through a plurality of intermetal insulating layers.

13. (Original) The method according to claim 1, wherein exposing the metallic layer to the reducing plasma is carried out in an environment in which forming the damascene opening is carried out.

14. (Original) The method according to claim 13, wherein the environment comprises a chamber.

15. (Original) The method according to claim 14, further comprising operating the chamber in a substantially vacuum environment.

16. (Original) The method according to claim 1, wherein forming the damascene opening and exposing the metallic layer to the reducing plasma are carried out in an environment having less oxygen than ambient air.

17. (Original) The method according to claim 1, wherein exposing the metallic layer to the reducing plasma is for about 10 to about 60 seconds.

18. (Original) The method according to claim 1, wherein exposing the metallic layer to the reducing plasma is for about 10 to about 30 seconds.

19. (Original) The method according to claim 1, further comprising providing the reducing plasma at a pressure of about 100 milliTorr.

20. (Original) The method according to claim 1, further comprising forming a diffusion barrier layer over the damascene structure before forming the metallic plug.

21. (Original) The method according to claim 20, further comprising forming the diffusion barrier layer to include tungsten-nitride.

22. (Original) The method according to claim 1, further comprising conducting the cleaning process as a wet cleaning process.

23. (Original) The method according to claim 22, further comprising conducting the wet cleaning process employing aqueous dilute hydrofluoric acid.

24. (Original) The method according to claim 1, further comprising forming the metallic plug to comprise the same metal as the metallic layer.

25. (Original) The method according to claim 1, further comprising forming the metallic plug to comprise copper.

26. (Previously Presented) A metallic damascene structure comprising:
a substrate;
a metallic layer extending over at least a portion of a surface of the substrate, the metallic layer including an at least partially reversed oxidation injury;
an insulating layer extending over at least a portion of the metallic layer;
a damascene opening extending through at least a portion of the insulating layer and exposing at least a portion of the metallic layer, the at least a portion of the metallic layer exposed through the damascene opening comprising the at least partially reversed oxidation injury of the metallic layer; and
a metallic plug in the damascene opening, the metallic plug in electrical connection with the metallic layer.

27. (Original) An electronic device comprising the metallic damascene structure of claim 26.

28. (Original) The electronic device of claim 27, wherein the electronic device comprises a memory device or a processor.

29. (Previously Presented) An electronic system, comprising:
a microprocessor; and
an integrated circuit coupled to the microprocessor;
wherein at least one of the microprocessor and the integrated circuit comprises a metallic damascene structure comprising:
a substrate;
a metallic layer extending over at least a portion of a surface of the substrate, the metallic layer including an at least partially reversed oxidation injury;
an insulating layer extending over at least a portion of the metallic layer;
a damascene opening extending through at least a portion of the insulating layer and exposing at least a portion of the metallic layer, the at least a portion of the metallic layer exposed through the damascene opening comprising the at least partially reversed oxidation injury of the metallic layer; and
a metallic plug in the damascene opening, the metallic plug in electrical connection with the metallic layer.

30. (Original) The electronic system of claim 29, wherein the microprocessor and the integrated circuit are integrated on the same chip.

31. (Original) A metallic damascene structure formed on a semiconductor substrate, the metallic damascene structure comprising an at least partly reversed oxidation injury in a metallic layer thereof.

32. (Original) An electronic device comprising a metallic damascene structure formed on a semiconductor substrate, the metallic damascene structure comprising an at least partly reversed oxidation injury in a metallic layer thereof.

33. (Original) An electronic system, comprising:
a microprocessor; and
an integrated circuit coupled to the microprocessor, at least one of the microprocessor and
integrated circuit comprising a metallic damascene structure formed on a semiconductor
substrate, the metallic damascene structure comprising an at least partly reversed
oxidation injury in a metallic layer thereof.